

APPENDIX

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

Saket CHADDA

Application No.: 10/025,010

Filed: January 17, 2002

Attorney Docket No.: SFI 1017

Examiner: Maurina T. Rachuba

Art Unit: 3723

FOR: METHOD FOR POLISHING COPPER ON A WORKPIECE SURFACE

DECLARATION OF SANJAY BASAK UNDER 37 C.F.R. § 1.131RECEIVED
CENTRAL FAX CENTER

SEP 17 2004

SANJAY BASAK, states that:

1. I reside at 4531 E. Sandia Street, Phoenix, Arizona 85044, and make this declaration of my own knowledge and belief.
2. I am the process technologist for the CMP Business Unit of Novellus Systems, Inc., formerly known as Speedfam-IPEC Corporation ("Novellus"). I am employed by Novellus which is located at 300 North 56th Street, Chandler, Arizona 85226.
3. I am one of the inventors named in U.S. patent application number 10/052,010 (the "current application"), filed January 17, 2002.
4. I, along with Krishna Murella, conceived the subject matter of at least independent claim 1 in the current application prior to July 25, 2001.
5. As evidence of my conception of at least the subject matter of independent claim 1 prior to July 25, 2001 is the invention disclosure dated March 2, 2001 that discloses my invention.

6. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

Executed on

Sept. 16, 2004
Sanjay Basak



SpeedFam-IPEC

Assigned Docket No.: 949Date Submitted: March 02, 2001

INVENTION RECORD

(Forward both a completed electronic copy and a signed and witnessed hard copy to the Legal Department)

1. IDENTIFICATION OF INVENTORS

INVENTOR 1:

Name SANJAY BASAK SSN 122-62-6457

Residence 444 N. GILA SPRINGS BLVD. #2052, CHANDLER, AZ 85226 INDIA
Street City State Zip Citizenship

Division Process Dept. Engineering Tel. Ext. 2402 Supervisor DAN TROJAN

Employer (If not SpeedFam-IPEC): _____

INVENTOR 2:

Name KRISHNA P. MURELLA S.S. # 601-08-0026

Residence 1250 W. GROVE PKWY; # 1038 TEMPE AZ 85283 INDIA
Street City State Zip Citizenship

Division Process Dept. Engineering Tel. Ext. 2581 Supervisor DAN TROJAN

Employer (If not SpeedFam-IPEC): _____

Name #3. JOE HERNANDEZ

Name #4. FRED MITCHEL

(If more than two inventors attach additional form)

2. TITLE (Descriptive): CMP PERFORMANCE (RATE) ENHANCEMENT BY IN-SITU CHEMICAL TREATMENT OF WAFER SURFACE
The Copper removal rate can be significantly increased by chemical treatment on the CMP tool prior to CMP. This does not require any change in mechanical conditions (pressure, velocity etc.)

3. BACKGROUND OF THE INVENTION: Describe below the problems and shortcomings of the existing technology in the area of your invention.

Increasing the removal rate in copper CMP is a constant challenge to process engineering. This is particularly important for polishing higher level (M4 and higher) copper where large thickness (>2um) of Cu polish is necessary. Achieving high removal rate without applying very high pressure is a big challenge with the available

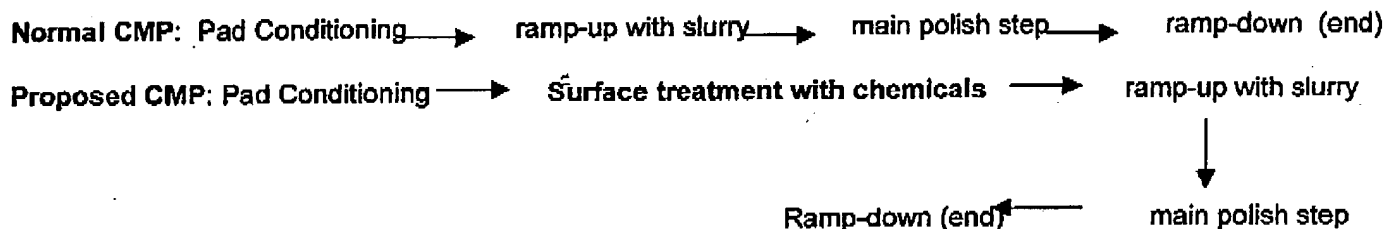
slurries, particularly, the abrasive-free slurry.

As plated, the copper surface has a thin layer of copper oxide formed under ambient condition. At the initial stage of copper CMP, the removal of passive oxide layer and generating the reaction intermediate (Cu^{2+}) is necessary to maintain a steady removal rate.

Commercially available copper slurries contain many additives including chelating agents and inhibitors whose primary function is to protect the newly generated surface by forming a protective layer. Many of these passivation layers become resistant to further CMP polish making the wafer surface completely resistant to re-polish which may be required to remove any residual copper.

We propose an in-situ chemical treatment of the wafer surface with organic compounds before CMP to break the passivation layer and increase in removal rate while operating within the mechanical envelop (pressure, rpm etc) of the CMP tool.

4. **DRAWINGS:** In the space below provide drawings, circuit diagrams, flow charts, photos, etc., as needed to clearly describe the invention. Identify each element of the invention with a reference numeral, and refer to the reference numerals in the description section below.



5. DESCRIPTION OF THE INVENTION:

5.1 With reference to the above drawings and reference numerals describe the invention IN DETAIL, specifically identifying and describing each element, and explaining how the elements function together to achieve the invention.

In the proposed process, the wafer surface is treated with the proposed chemical (s) before it is exposed to the slurry. The treatment can be done insitu at the polishing pad while the wafer is in contact with the pad. The chemical is supplied by one of the peristaltic pump of the CMP tool. With this pre-treatment, the copper surface gets activated and produces higher removal rate during CMP.

So far, we have tested with dilute oxalic acid. We believe that the claim can be extended to wide range of organic acids, e.g., citric, malonic acid etc. Also this process can be used with wide range of concentrations and with different slurries.

5.2 Explain how the invention solves the existing problems described above in the Background section.

We have demonstrated the efficacy of this pre-treatment in terms of increasing higher removal rate in various tool setups:

- Both 200mm and 300mm Cu CMP processes
- Both Orbital and rotational platforms
- With two different slurries (Hitachi and Eternal)

3/2/01

Doc. #2189 v1

| Tool condition | slurry | conventional CMP removal rate (A/min) | surface treated CMP removal rate (A/min) |
|--------------------------------------|---------------|--|--|
| 300mm orbital POR Rotational tool | Hitachi 430-1 | 3982 rate drops significantly For longer polish time | 5276 (30% increase) polishing action can be regenerated after surface Treatment |
| 200mm orbital | " | 4964 | 5631 (15% increase) |

5.3 Explain specifically what is novel about the invention.

- Removal rate can be increased by chemical treatment prior to CMP without changing mechanical conditions (pressure, velocity).
- Polishing action can be regenerated when rate dies due to formation of passivation layer.
- Previously polished wafer can be re-polished to remove copper residue.


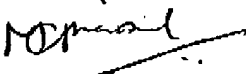
6. Has information relating to the invention been given to persons outside SpeedFam-IPEC? ☐ YES ☒ NO
If so, give all dates and details. If not, when is same expected?

7. Has the invention been constructed, tested, or otherwise reduced to practice? ☒ YES ☐ NO
If so, when, where (specify Laboratory, Customer Facility, or elsewhere), and to what extent? If not, when is it expected to begin?

Tested at R&D center, SpeedFam-IPEC, Chandler, AZ

8. Has there been any publication, offer for sale, or public use of this invention? ☐ YES ☒ NO
If so, when, where, and to whom? If not, when is same expected?

The undersigned have read and understood this Invention Record (two witnesses required):

| | | | |
|---|------|--|----------------|
| INVENTION RECORD WITNESS (SIGNATURE) | DATE | INVENTOR 1 (SIGNATURE)  | DATE 3/2/01 |
| INVENTION RECORD WITNESS (SIGNATURE) | DATE | INVENTOR 2 (SIGNATURE)  | DATE 3/2/01 |

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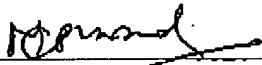
FOR: METHOD FOR POLISHING COPPER ON A WORKPIECE SURFACE**DECLARATION OF KRISHNA P. MURELLA UNDER 37 C.F.R. § 1.131**

KRISHNA P. MURELLA, states that:

1. I reside at 15043 S. 47th Way, Phoenix, Arizona 85044, and make this declaration of my own knowledge and belief.
2. I am a process engineer, for the CMP Business Unit of Novellus Systems, Inc., formerly known as Speedfam-IPEC Corporation ("Novellus"). I am employed by Novellus which is located at 300 North 56th Street, Chandler, Arizona 85226.
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Executed on

9/16/04

Krishna P. Murella



SpeedFam-IPEC

Assigned Docket No.: 949Date Submitted: March 02, 2001

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PAGE 19/21 * RCVD AT 9/17/2004 5:23:02 PM [Eastern Daylight Time] * SVR:USPTO-EFXXRF-1/2 * DNIS:8729306 * CSID:4803855061 * DURATION (mm-ss):05-22

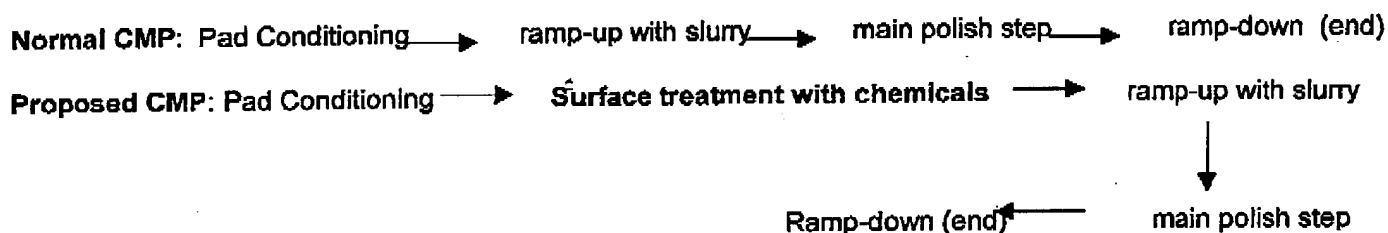
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The undersigned have read and understood this Invention Record (two witnesses required):

| | | | |
|---|------|---|-----------------|
| INVENTION RECORD WITNESS (SIGNATURE) | DATE | INVENTOR 1 (SIGNATURE) <i>Sally B...</i> | DATE 3/02/01 |
| INVENTION RECORD WITNESS (SIGNATURE) | DATE | INVENTOR 2 (SIGNATURE) <i>Michael</i> | DATE 3/2/01 |

3/2/01

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